

The Cost of Reducing Emissions

EES 3310/5310

Global Climate Change

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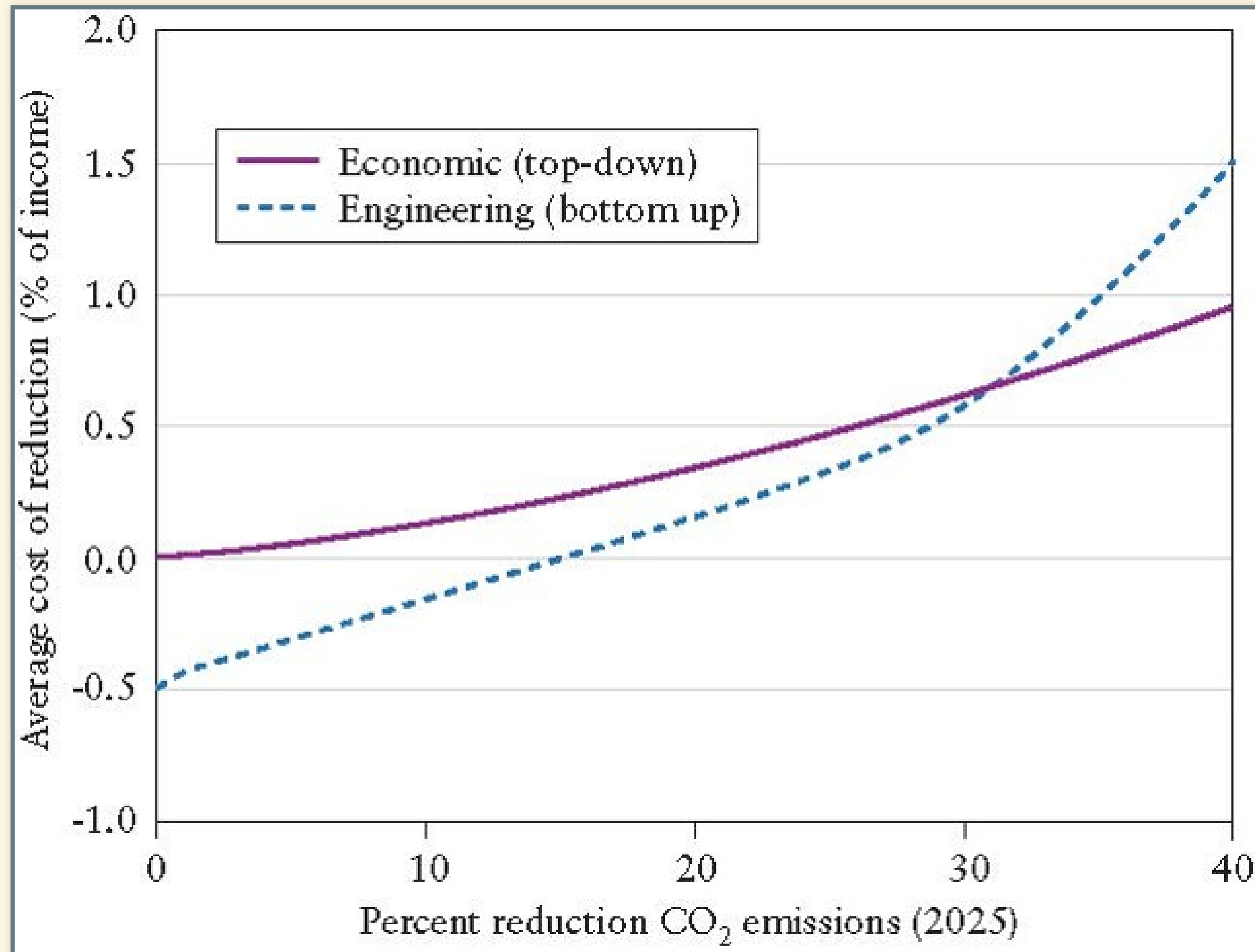
Class #27: Friday, March 26 2021

Big Concepts

Big Concepts

- Cost per ton of reducing emissions
 - Marginal vs. average cost
 - Diminishing marginal returns on investment (increasing marginal cost of mitigation)
- A different look at top-down vs. bottom-up
- Implications for policy:
 - The importance of participation
 - The need for new technology
 - Market-driven vs. command-and-control
- Comparison:
 - Pielke vs. Nordhaus

The cost of reducing emissions



Top-down vs. Bottom-up

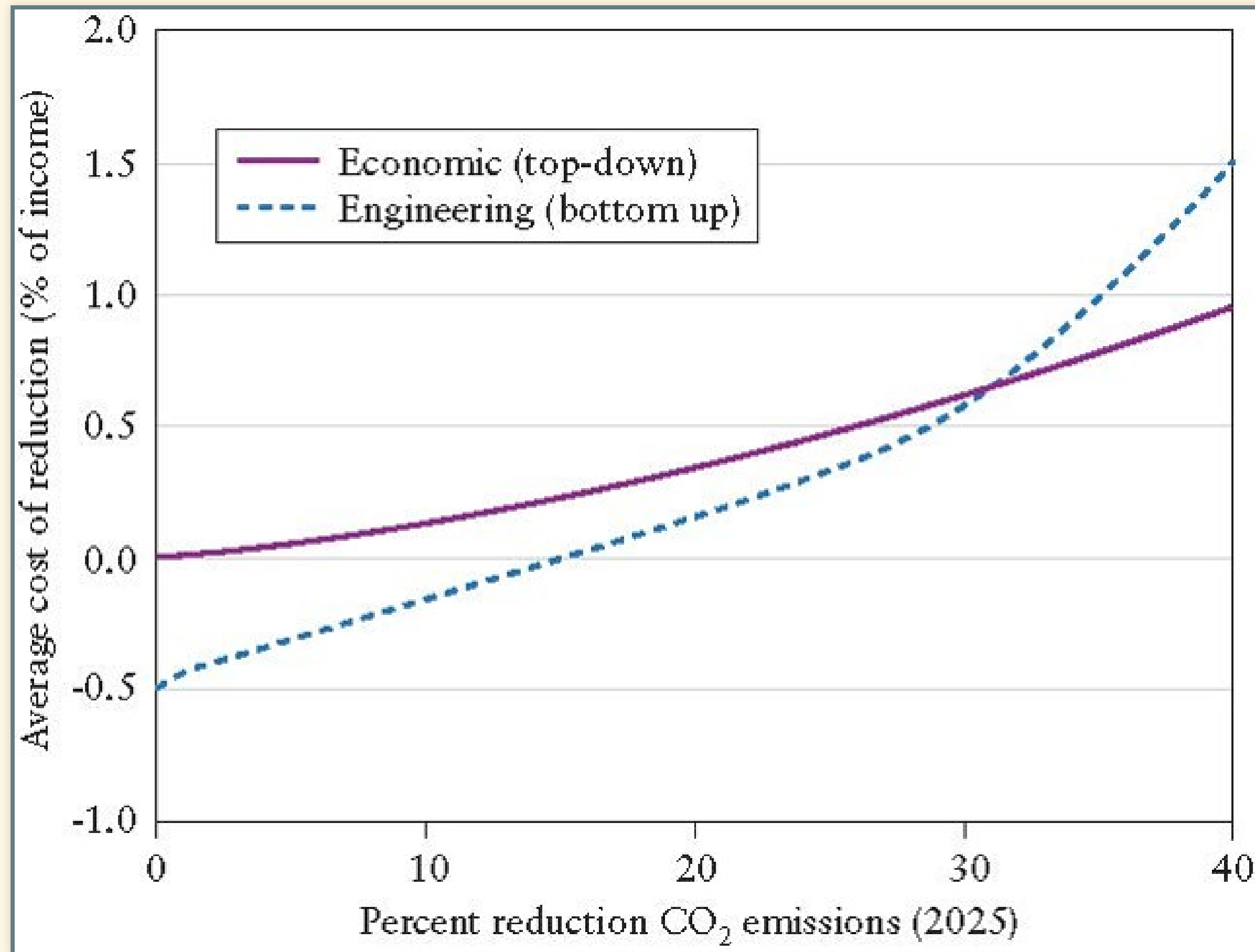
Climate Fix (Pielke)

- **Top-down** = macroeconomic calculation
- **Bottom-up** = individual components of Kaya identity:
 - Technology:
 - e = energy intensity
 - f = carbon intensity

Climate Casino (Nordhaus)

- **Top-down** = macroeconomic calculation
- **Bottom-up** = Engineering:
 - Individual energy technologies
 - Nuclear
 - Coal
 - Gas
 - ...

The cost of reducing emissions



Assumptions

Top Down

- No negative-cost options
 - \$100 bill on sidewalk
 - Examples:
 - ...

Bottom Up

- All technology is new
 - What about existing infrastructure?

Potential for Emissions Reduction

Nortel

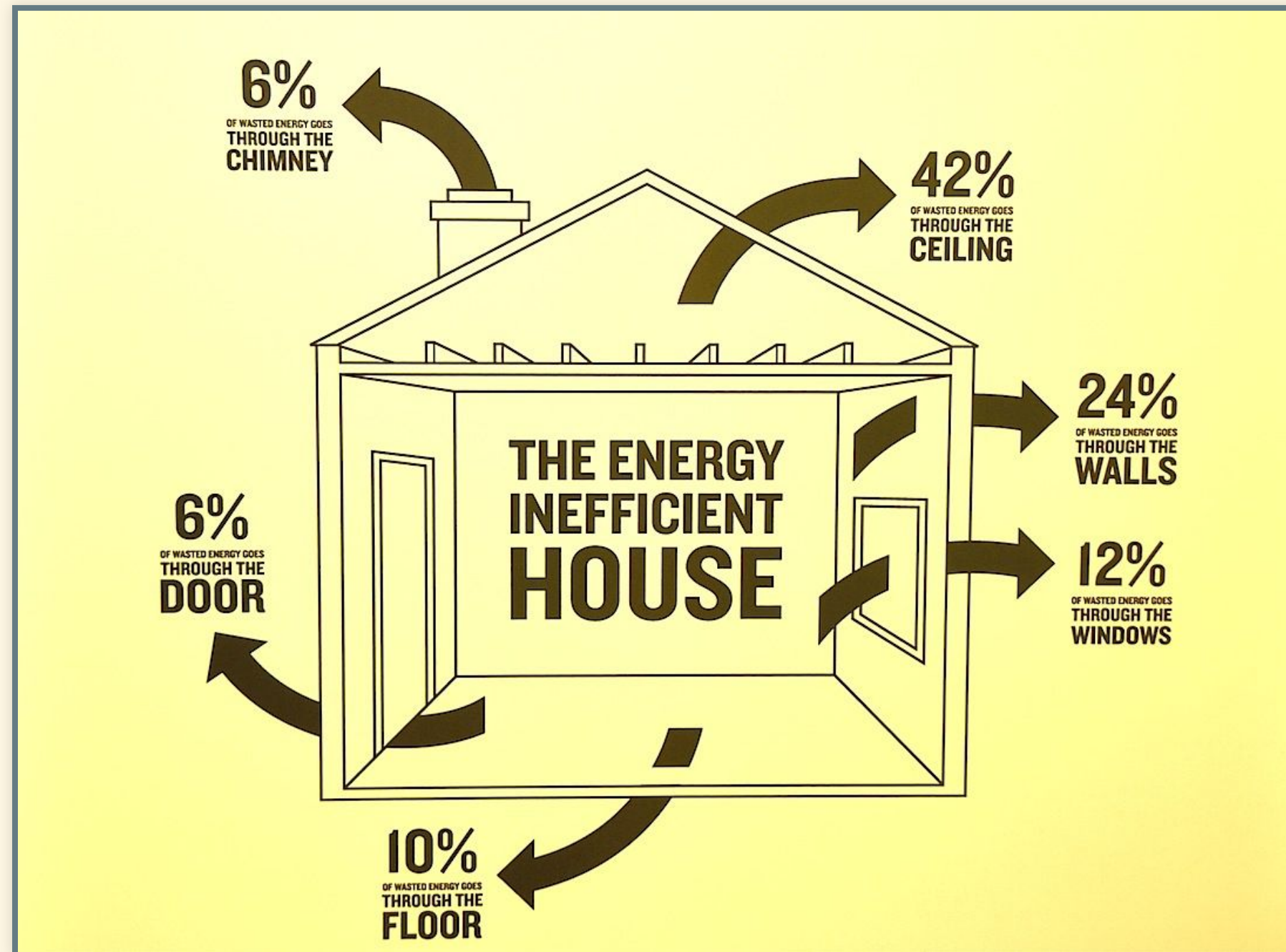
- Electronics manufacturing
 - CFC-113 for cleaning circuit boards
 - Cheap, safe
- Concern about ozone layer:
 - 1988: Voluntary pledge to eliminate CFCs
 - Citrus-based cleaner:
 - Even cheaper
 - No chemical disposal costs
 - \$1 million initial costs
 - \$4 million savings in first 3 years

Walker's Crisps



- British snack-food company
 - Makes potato chips
 - Buys potatoes by the pound
- Farmers sell by the pound
 - Make sure potatoes are as wet as possible
 - Humidified warehouses
 - Cost of shipping
- Dry potatoes make better chips
 - Walker's must dry potatoes
 - Cost of heating, dehumidifying
 - Changed the way they bought potatoes
 - Saved money, reduced CO₂ emissions

Home energy efficiency

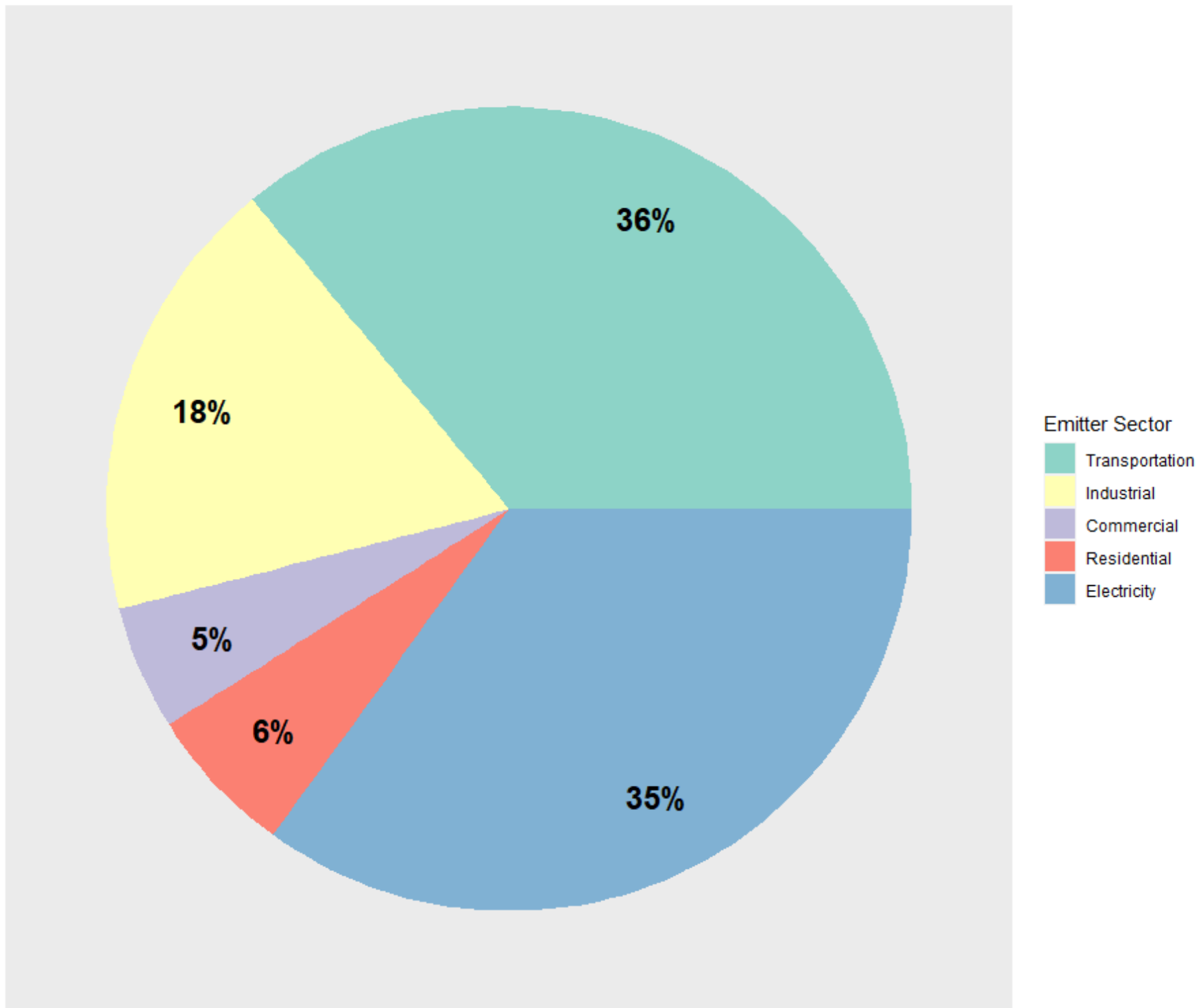


- Insulation, weatherization
 - \$1000 on sealing leaks saves \$500 per year
 - Improving insulation
 - Costs \$0.25–\$2.75 per square foot
 - Savings \$0.50–\$2.90 per square foot per year
 - Payback time <1 year to 6 years
- So why don't people do things that save money and help environment?
 - Don't know what to do
 - Too much bother/inconvenience
 - Can't afford up-front costs
 - ...

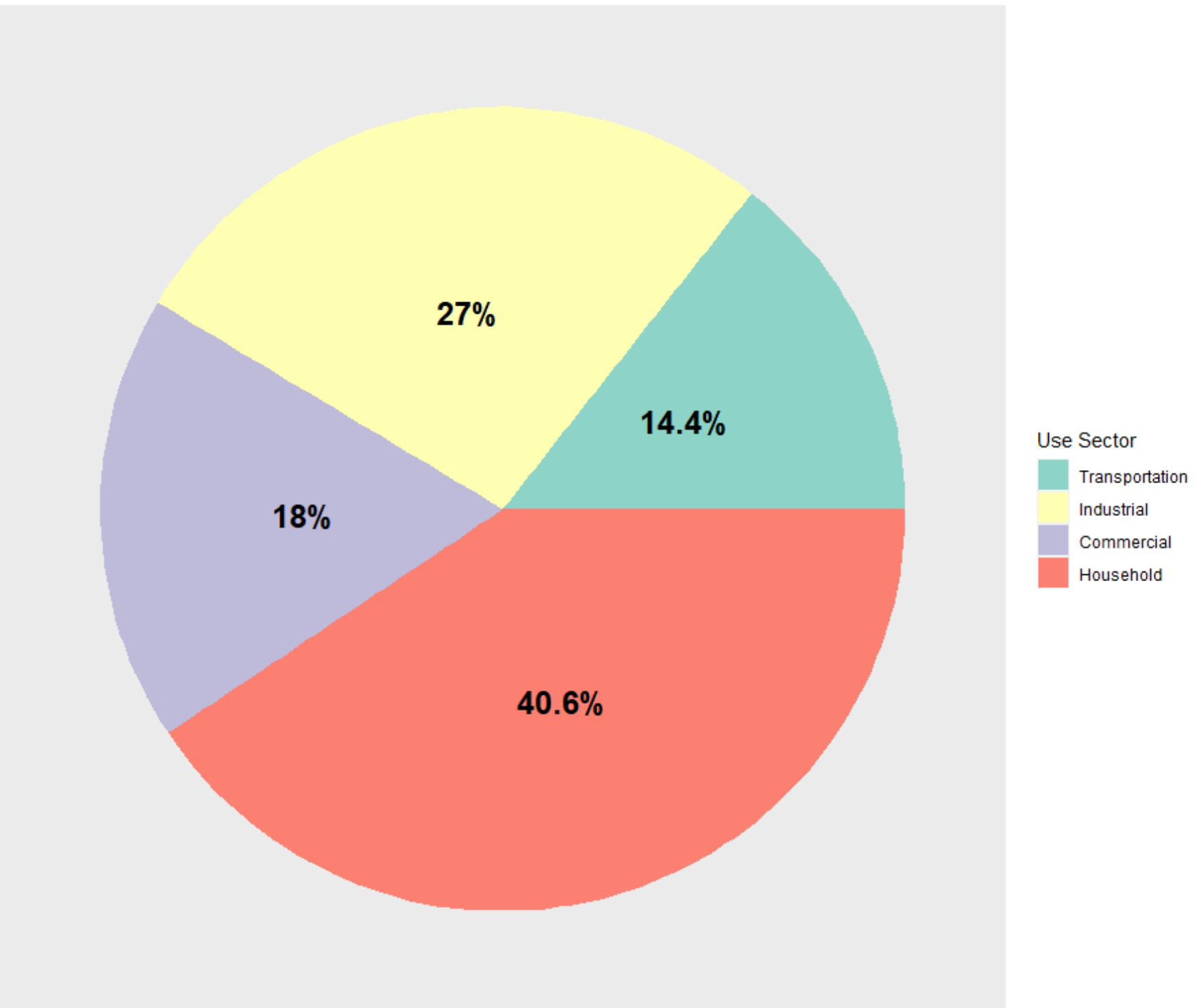
The Household Sector

Who Emits CO₂?

CO₂ emissions by sector of emitter



CO₂ emissions by sector of user



“The Behavioral Wedge”

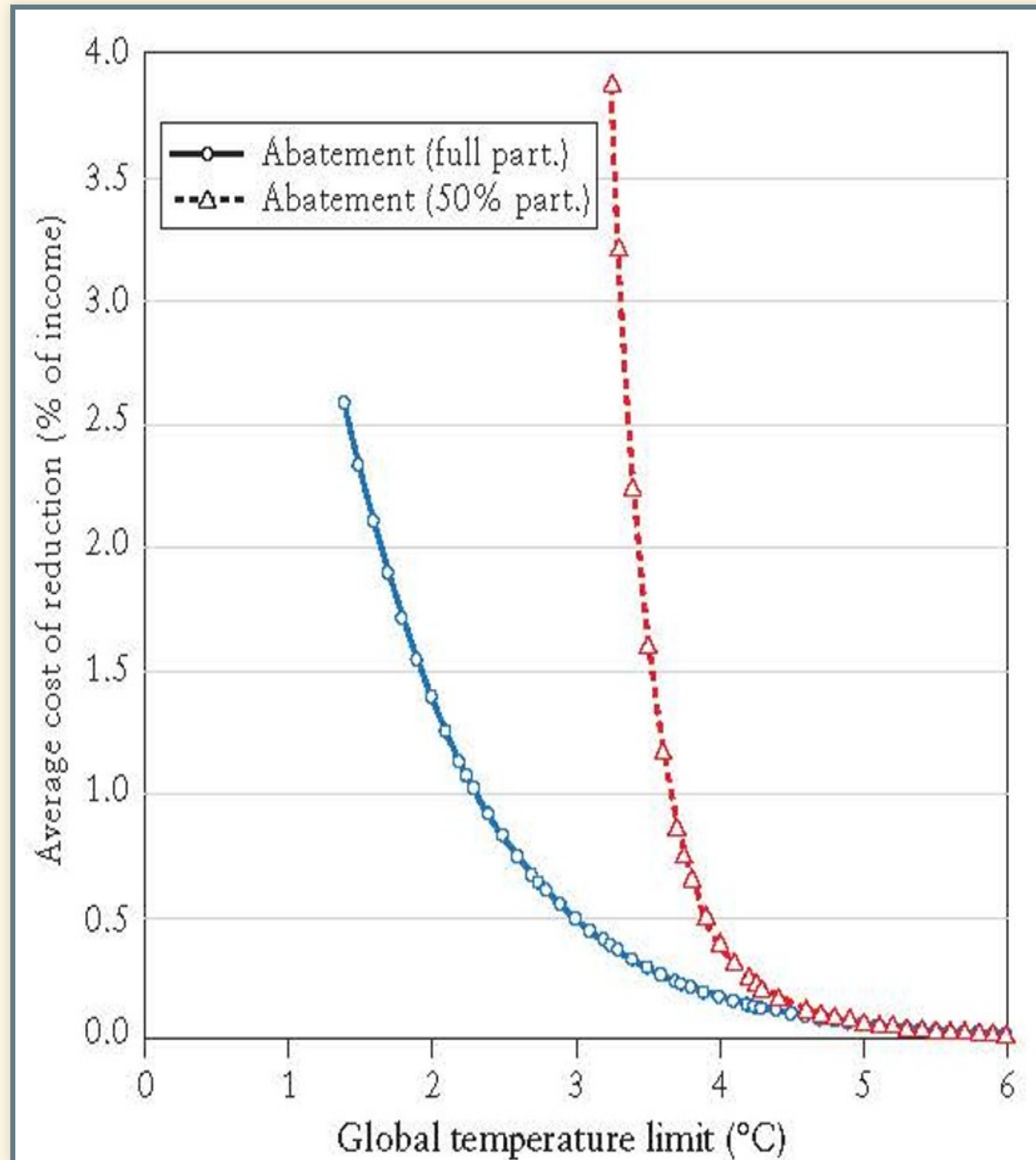
- Dietz, Gardner, Gilligan, Stern, & Vandenberg (2009)
- Households can cut emissions ~38%
- With the right incentives, households could be persuaded to cut emissions 20%
 - 450 million metric tons of CO₂ per year
 - 7.35% of total US emissions
 - More than the whole nation of France

Policy Implications

Climate Casino on Policy

- Different actions have different costs/ton
 - Same action may have different costs at different firms
- Government doesn't know enough to micromanage actions efficiently
 - Put a cost on carbon and let market allocate actions
 - Those who can cut emissions cheaply do a lot
 - Those for whom cutting emissions is expensive do less
 - What matters to the environment is total cuts, not whether everyone cuts the same amount.

Participation



Full participation vs. only countries representing 50% of emissions

Nordhaus on Policy

The favorite policies of most countries today are energy efficiency regulations....

However, such regulations will not touch the area where reductions are most economical—electricity generation from coal. ...

[C]areful analyses show that coal is king when it comes to reducing CO₂ emissions.

Nordhaus on Policy

Economists and policymakers do not have the information to micromanage the energy system for 315 million Americans or 7 billion earthlings.

The economy is too complicated and evolves too rapidly.

Rather, ... economists emphasize that policy should be designed to provide strong incentives to reduce CO₂ emissions and to develop new low-carbon technologies.

Bill Gates on Policy

- We need an energy revolution
- Put a price on carbon to motivate the market
- But ...
 - Markets are not good at revolutionizing energy
 - Failure rates of venture-capital investments
 - Government does very well at investing in basic research
 - Calls for massive government support for energy R&D